PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1958-59

TANGANYIKA TERRITORY
LAKE PROVINCE

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TANGANYIKA TERRITORY
LAKE PROVINCE
PROGRESS REPORT FOR THE SEASON 1958-59

COTTON SEASON

Planting: Ukiriguru, early December, 1958, to mid January, 1959.
Picking: Ukiriguru, early May, 1959, to mid July, 1959.
Legal uprooting date: 15th September, 1959.
Rainfall for the period 1st October, 1958, to the end of June, 1959:
Ukiriguru: 22·04 inches.

INTRODUCTION

BY

G. M. WICKENS, M. H. ARNOLD, and K. J. BROWN

Ukiriguru Research Centre, Cotton Research Section

Visitors.—Of the many visitors to Ukiriguru during 1959, those whose visits were largely concerned with cotton included members of the World Bank Visiting Mission; Mr. J. Bellamy, Manager, Lint and Seed Marketing Board; Dr. E. W. Russell, Director, E.A.A.F.R.O.; Messrs. A. P. S. Forbes, J. G. M. King, and R. J. M. Swynnerton, Directors of Agriculture, Tanganyika, Uganda and Kenya respectively; Mr. C. K. Patel, M.L.C., President, Lake Province Ginners Association; Mr. P. Bomani, M.L.C., President, Victoria Federation of Co-operative Unions; Mr. H. L. Manning, Director, and Dr. J. E. Dale, Dr. D. M. Robinson, Mr. P. H. Le Mare and Dr. D. A. Perry, all of the Namulonge staff, the last two on a number of occasions for soil and Fusarium wilt studies respectively.

Staff.—Mr. J. E. Peat left Ukiriguru on 25th July, on retirement after almost 20 years as officer in charge of the station. Dr. G. M. Wickens arrived from Namulonge in August and took over as the Corporation's Senior Officer in Tanganyika and as head of the Ukiriguru Cotton Research Section, Western Regional Research Centre. Mr. and Mrs. K. J. Brown were on leave from 21st July to 19th October 1959, and Mr. A. M. Kabaara continued his work at Aberdeen University where he is studying under a two-year research studentship. Dr. Wickens attended the Namulonge Advisory Board meeting at Namulonge in December and the Central Regional Research Committee meeting at Ilonga in September, and together with Mr. M. H. Arnold the Western Regional Research Committee meeting at Ukiriguru in October and a conference on cotton breeding policy in relation to market requirements held in Dar es Salaam on 27th November. Mr. Arnold visited Aden Protectorate from 13th to 22nd November.

Rainfall.—Total rainfall for the season (22·04 inches) was considerably lower than the 28 year average of 31·44 inches, only three seasons having had less. Monthly totals are given below.

Monthly rainfall in inches, October, 1958, to June, 1959

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	Total
1·61	1·18	4·94	1·86	1·58	3·90	4·32	2·65	Nil	22·04

December rains were good, and all cotton on Ukiriguru was planted by early January. Growth was good until late February, but thereafter long spells of inadequate soil moisture led to acute water stress in the plants when they were approaching maximum leaf area. This was followed by considerable leaf shedding; data from crop development studies indicated that up to one-third of total leaf area was shed during this period. April rains, falling mostly in the latter half of the month, came too late for there to be any appreciable recovery in terms of crop harvested, although the plants became leafy and free-flowering again in May and June.

Similar drought periods occurred over most of Sukumaland, though to the North, in Nassa and in Musoma District, rainfall was generally good.

Lake Province Cotton

A record crop was produced for the sixth consecutive season, the total of 183,211* bales exceeding the previous season's crop by more than 30,000. In view of the droughty weather over much of Sukumaland, this record production is all the more remarkable, and illustrates the still growing enthusiasm of the peasant cultivator for planting increasing quantities of what is by far the major cash crop in the Province.

Most of the Province was planted to Uk51. About 35 tons of Uk55 and 4½ tons of Uk58 were planted for multiplication.

Adverse reports on the lint quality of Uk55 were received from classifiers and merchants. All present evidence from strictly comparative quality tests of the Ukiriguru seed issues indicates that the inherent quality of Uk55 is up to the accepted standards of Lake Province cotton, and that shortcomings in the samples which led to complaint were caused by environmental factors. Nevertheless, as a safeguard against damaging the market reputation of Lake Province cotton, the Department of Agriculture has temporarily limited the multiplication of Uk55, pending results from further comparative trials.

Agronomy and Crop Physiology

BY

K. J. BROWN

It has been a difficult season for cotton growth on Ukiriguru and the plants suffered to a varying extent depending on the stage of growth at the time of the most severe drought periods. The better the growth of the cotton up to the onset of these periods, the worse was the setback that the plants received. This is illustrated in Table 1 by the yield figures from the exhaustion and "high field" plots over the past three seasons.

*Provisional figure given by the Department of Agriculture, subject to minor adjustment, and including 892 bales from Western Province.

TABLE 1.
Ukiriguru—Hill sand—Trial 25

Year	*Yield in lb./acre seed cotton*	
	High Field	*Exhaustion*
1956-7	2,050	413
1957-8	2,300	508
1958-9	1,083	546

Time of Planting

The design of the time of planting trial was essentially the same as in 1958, but a nitrogen application was included to give a 2 × 4 factorial arrangement with the 4 times of planting (Table 2). As before, the plots were split to carry 6 strains varying in their rates of crop maturation.

Nitrogen application was introduced with the object of determining whether the yield of an early variety, planted late, could be raised to approach that of the present commercial varieties planted early. There was found, however, no obvious interaction to indicate such an effect, possibly because of the unusually short effective cropping season.

Main effects are presented in Table 2. There was a very marked drop in yield of 47% between cotton planted on 6th January and that planted three weeks later on 27th January, giving further confirmation of the soundness of the advice to growers to plant all cotton before mid January.

TABLE 2.
TIME OF PLANTING EXPERIMENT
Ukiriguru—Hill sand—Trial 45

Started 1957-58.
6 replications of 4 times of planting × 2 levels of nitrogen. Main plots of 1/27·5 acre, each planted with 6 varieties.
5-foot ridges, 2 rows at 18″ spacing, 2 plants per hole.
Sulphate of ammonia applied to nitrogen plots at 100 lb./acre.

Main effects: seed cotton lb./acre

Planting Date	24th Nov.	16th Dec.	6th Jan.	27th Jan.
n_0	1174	1160	1048	560
n_1	1337	1273	1107	710
S.E. (L.S.D. 5%)	±27·8	(86)		

Manuring and Fertilizers

Trial 8 was continued. The original application of 1½ tons cotton seed ash still gave a significant increase in yield after 15 years of cropping of 141 lb./acre seed cotton over a control yield of 467 lb. The addition of sulphate of ammonia to the control gave no increase and this probably reflects the very low phosphate status of the exhausted control plots, as sulphate of ammonia applied to the residual ash plots gave a yield increase of 155 lb./acre seed cotton over the yield of the plots with ash alone.

The results from Trials 9, 26 and 44 are given in Tables 3, 4 and 5 respectively. The most obvious feature from all these three trials is the reduced responses to the highest levels of manure and fertilizers.

The control yields of Trials 9 and 26 are almost identical to last year, but the highest levels of manuring gave increases over the controls of 36% and 70% respectively, compared with increases of 100% and 175% in 1958.

Trial 44 gave smaller increases than usual with nitrogen and phosphate fertilizers. The application of gypsum gave no response at all and it would appear that there is no important deficiency of sulphur in these soils.

TABLE 3.

NPD EXPERIMENT

Ukiriguru—Hill sand—Trial 9

Started NPK (1947-48)

NPD (1950-51). Re-applied 1956-57, 6 tons compost, 75 lb. and 150 lb. basic slag and urea 90 lb./acre applied 23rd February 1959. $2 \times 2 \times 3$ factorial with NPD and ND interactions partially confounded testing all combinations of: —

n_0, n_1, 0, 90 lb. urea/acre
d_0, d_1, 0, 6 tons compost/acre
p_0, p_1, p_2, 0, 75, 150 lb. basic slag/acre

6 replications in 12 blocks of 6 plots, each 1/69·7 acre. Compost and phosphate re-applied November, 1956. Cotton planted 21st December, 1958. Third indicator crops of the fourth cycle.

Mean yields: seed cotton lb./acre

	(1)	d	n	nd	Mean
p_0	939	1231	991	1119	1070
p_1	1027	1236	1078	1324	1166
p_2	1236	1224	1172	1279	1228
Mean	1067	1230	1080	1241	

S.E. (L.S.D. 5%) any treatment total ±56·7 (161)
S.E. (L.S.D. 5%) phosphate means ±23·1 (66)
S.E. (L.S.D. 5%) nitrogen means ±23·1 (N.S.)

TABLE 4.

NPD EXPERIMENT

Ukiriguru—Hill sand—Trial 26

5 replications of 2×2 factorial, with main plots split into 4 nitrogen treatments of 1/69·7 acre each. Compost and phosphate applied in 1952 and 1955. Sulphate of ammonia applied at flowering, 10th March, 1959.

5-foot ridges, 2 rows of 18" spacing, 2 plants per hole. Cotton planted 3rd January, 1959.

p_0, p_1, 0, 150 lb. double superphosphate/acre.
d_0, d_1, 0, 6 tons compost/acre.
n_0, n_1, n_2, n_3, 0, 50, 100, 200 lb. sulphate of ammonia/acre.

Mean yields: seed cotton lb./acre

Nitrogen treatments (applied each season)	*Fourth indicator crops from dressings of compost and phosphate*				
	(1)	d	p	pd	Mean
n_0	534	812	642	876	716
n_1	611	837	736	860	761
n_2	683	852	776	941	813
n_3	601	823	834	911	792
Mean	607	831	747	897	

S.E. (L.S.D. 5%) sub plots in any main treatment ±58·4 (167)
S.E. (L.S.D. 5%) any comparison of sub plots ±74·9 (214)
S.E. (L.S.D. 5%) of means for nitrogen ±29·1 (83)
S.E. (L.S.D. 5%) of means of phosphate and compost ±39·2 (121)

TABLE 5.

NPS EXPERIMENT

Ukiriguru—Hill sand—Trial 44

Started 1957-58. Phosphate and gypsum applied 22nd November, 1957. urea and sulphate of ammonia applied 9th March, 1959.

$2 \times 2 \times 3$ factorial partially confounded, testing all combinations of:—

n_0, n_1, n_2,	0,	200 lb./acre sulphate of ammonia. 90 lb./acre urea.
p_0, p_1,	0,	100 lb./acre double superphosphate.
s_0, s_1,	0,	280 lb./acre gypsum.

6 replications in 12 blocks of 6 plots, each 1/69·7 acre. Cotton planted 5th January, 1959.

Second indicator crop.

Mean yields: seed cotton lb./acre

	(1)	p	s	ps	Mean
n_0	858	1069	973	1028	982
n_1	1173	1180	1101	1062	1129
n_2	1066	1163	1104	1237	1142
Mean	1032	1137	1059	1109	

S.E. (L.S.D. 5%) of any treatment mean	±65·3 (187)
S.E. (L.S.D. 5%) of nitrogen means	±32·5 (93)
S.E. (L.S.D. 5%) of phosphate means	±26·6 (76)
S.E. (L.S.D. 5%) of sulphur means	±26·6 (N.S.)

This is the last year in which Trials 8, 9 and 44 will be planted to cotton. In future years Trials 8 and 44 will be cropped with maize and Trial 9 will be discontinued.

Growth Studies

This season, for the first time, extensive growth analyses were made on selections from Mwanza Local and Albar hybrids. Preliminary examination of the data has revealed strain differences in response to the severe drought conditions this season. This work is to be continued with the hybrid material to try to assess the type or types of plant needed, from amongst the very complete range available, for Lake Province conditions.

Growth and chemical analyses of material sampled from the nitrogen and phosphate plots of Trial 26 showed that nitrogen in the form of sulphate of ammonia which was applied on 10th March gave no noticeable effect in increasing plant growth at the sampling on 23rd March, but did so at the next sampling on 7th April.

Rain fell on 21st and 22nd March in two storms of 0·25 and 1·05 inches, the next sampling date being on 23rd March. There was a suggestion of an increase in %N of the leaves taken from those plots which had received sulphate of ammonia, but the main plant growth response was measured over the following fortnight from the samples taken on 7th April.

It would appear that there is a rapid uptake of nitrogen on these soils provided that soil moisture is adequate, but as the sulphate of

ammonia is top dressed in the first inch or two of the ridge, this zone can rapidly dry out, resulting in a delayed effect from the fertilizer. This point will be further investigated this year, in addition to the effect of nitrogenous fertilizer applied at planting time.

The meteorological equipment is to be increased to obtain more accurate data to which the strain/environment response can be related.

Soil Chemistry

BY

P. H. LE MARE (Namulonge, Uganda)

In the absence of Mr. Kabaara at Aberdeen, no formal soil chemistry has been done at Ukiriguru during the year. The chemical assistant, Mr. Nyonyi, has been seconded to Mr. K. J. Brown to help with his studies in crop physiology, and he has carried out chemical analyses for Mr. Brown.

The studies in crop physiology are related to certain aspects of soil chemistry at Ukiriguru, and will be valuable in the interpretation of soil data.

Soils from Ukiriguru are being investigated as part of the study of the effects of fallows and leys on soil fertility being carried out at Namulonge. In these studies, particular importance is being given to phosphate and its relationship with organic matter. In this work the contrast in soil characteristics between the two centres is most valuable, as is the background of manurial and agronomic field studies at Ukiriguru.

Cotton Breeding

BY

M. H. ARNOLD and K. J. BROWN

At the beginning of the season, the three cotton breeding programmes, to which reference has been made in previous reports, were amalgamated. The material, now being handled side by side, consists of 8/290 derivatives, Albar hybrids, and hybrids in which the gene B_{6m} has been added both to Ukiriguru strains and to Albar hybrids.

The immediate objective of the programme is the production of commercial varieties, highly resistant to bacterial blight, with other field characters up to the standard of the most recent seed issues and satisfying the quality requirements of the industry.

All breeding stocks are stem-inoculated with *X. malvacearum* slime when approximately two months old. Susceptible plants are rogued out a month later and the remainder boll-inoculated. Final selections

are made from jassid resistant plants which also show a high degree of resistance to bacterial boll rot. Some 350 single plant selections have been carried forward to next season.

It is hoped that ultimately all selections will be tested in replicated progeny rows in the year following selection. This is not at present possible owing to the very wide range of selections being handled, but considerable experience has been gained in the management of replicated progeny rows and in the use of the selection index technique. Four trials of replicated progeny rows were completed, each consisting of 49 selections in a 7 × 7 balanced lattice square design.

A large number of strains was again tested in 'small bulks' trials, both on the station and in district plots. In all, 15 trials, each of 25 strains in a 5 × 5 balanced lattice design, were completed on the station and 16 on district plots and at Lubaga. As discussed in the agronomy section of this report, yields were lower than usual at Ukiriguru owing to the dry weather in March and April and, in consequence, yield responses of strains were difficult to interpret.

Results from district variety trials confirmed that the yield level in the more important families of Albar hybrids is comparable with that of the most recent Ukiriguru seed issues. Mean yields over all trials of the three seed issues now being grown commercially are shown in Table 6 compared with Mz561. The yield increases from the new seed issues were less than the average increases shown in last season's report. Again, this was almost certainly associated with the poor rainfall distribution over a large part of the growing area.

In view of the fact that doubts were expressed about the quality of Uk55 as grown in the multiplication area in Ushashi zone, a series of comparisons was sent to the Shirley Institute for small scale spinning tests. The results confirmed that the fibre and yarn characteristics of the three seed issues are very similar.

Comparable samples, including a selection of Albar hybrid strains, from 9 trials covering 8 widely separated localities were sent to be classified by the Lint and Seed Marketing Board in Dar es Salaam. From these samples the classifiers were unable to detect any consistent differences associated with varieties, the final classifications of the three seed issues Uk51, Uk55 and Uk58 being virtually identical.

TABLE 6.

MEAN YIELDS OF SEED ISSUES FROM NINETEEN VARIETY TRIALS—1959

	Seed cotton lb./acre	*G.O.T.*	*Lint lb./acre*	*% Mz561*
Mz561	823	32·9	271	100
Uk51	872	33·6	293	108
Uk55	906	34·7	314	116
Uk58	933	35·0	327	121

Bacterial Blight

BY

M. H. and K. M. ARNOLD

Work on Resistant Strains

An attempt was made this season to form some assessment of the yield increases to be expected from a highly resistant Albar hybrid under conditions of bacterial blight attack. In all, six trials were laid down on different sites on Ukiriguru, varying levels of bacterial blight being allowed to develop by varying the degree of efficiency of seed disinfection. Results for three sites, which illustrate the main effects, are shown in Table 7. On site III only one plant was observed with primary infection—the infection spreading to no more than ten adjacent plants during the season. The influence of the disease in this site may therefore be considered to have been nil.

The results show that, under this season's conditions, the Albar hybrid, E21/15/504, yielded slightly better than Uk51 where there was virtually no bacterial blight (site III) and gave a crop worth 49% more than Uk51 where bacterial blight was present in all its phases throughout the growing season (site I). This increase was made up partly by an increase in yield and partly by a decrease in the proportion of grade C seed cotton harvested. The figures for the percentage of grade C under bacterial blight attack (sites I and IV) follow the same trends as the figures for resistance to boll rot in these strains reported last season, and form an interesting illustration of the importance of bacterial boll rot in contributing to stained or damaged seed cotton.

One criticism which can be advanced against comparisons of this type is that interactions of strains with different levels of bacterial blight attack are confounded with interactions of strains with different levels of soil fertility. The strain E21/15/504 has now been extensively tested over a range of soil fertilities, however, and there seems to be no evidence that this strain responds better than Uk51 under poor conditions in the absence of bacterial blight. Thus although site I, in addition to suffering the worst attack of bacterial blight, was also the poorest in fertility, there is no doubt that the major factor in the increased yield of the Albar hybrid was the influence of the disease on the other strains and not a fertility interaction.

In addition to the inferences which can be made from these trials regarding yield responses of strains differing in resistance, inferences can also be made regarding the effect on yield of seed disinfection. Again, caution must be exercised, since small differences in the amount and distribution of rainfall between sites may influence the relative build-up of disease in those sites; nevertheless, the main picture as illustrated by the results in Table 7 may be taken as valid. This

TABLE 7.

RESPONSES OF STRAINS UNDER DIFFERENT LEVELS OF ATTACK BY BACTERIAL BLIGHT

Strain	*Site I* *Untreated seed.* *Moderate to severe bacterial blight throughout season*				*Site IV* *Seed treated with Abavit B at 1:150 w/w.* *Early attack light, becoming moderate to severe later*				*Site III* *Seed treated with Agrosan GN5 at 1:150 w/w.* *Very light throughout season*				*Means*	
	Seed cotton lb./acre	*% Grade C*	*Value Sh. acre*	*Value % Uk51*	*Seed cotton lb./acre*	*% Grade C*	*Value Sh. acre*	*Value % Uk51*	*Seed cotton lb./acre*	*% Grade C*	*Value Sh. acre*	*Value % Uk51*	*Seed cotton lb./acre*	*Value % Uk51*
Local	660	22·5	295·71	103	1026	12·5	492·40	85	1135	6·7	565·78	103	940	96
Uk51	627	19·1	287·77	100	1175	9·2	576·28	100	1111	7·9	549·82	100	971	100
Uk55	700	12·3	336·45	117	1144	6·5	571·17	99	1075	6·0	538·42	98	973	102
E21/15/504	867	7·8	429·34	149	1322	4·2	669·74	116	1197	7·3	594·38	108	1129	120
S.E.	±24				±30				±41					

clearly shows, comparing the Ukiriguru strains with the Albar hybrid, that seed disinfection leads to a reduction in the effects of bacterial blight on yield.

Work on the inheritance of resistance in Albar hybrids and strains of Local origin continued. Two trials, one of 46 and the other of 47 strains, were completed, data being obtained on stem and boll resistance assessed after needle inoculation. This work, details of which will be reported elsewhere, is an essential complement to the plant breeding programme in that it reveals the course of the inheritance of resistance with backcrossing and inbreeding and gives a safeguard against lines with inadequate resistance being allowed to pass the plant breeding "filter."

Seed Treatment

Seed treatment trials were continued with a view to determining the best dressing to use on a commercial scale, bearing in mind efficiency, economy and the characteristics of available seed dressing machinery.

It is now established that many mercurial formulations are more efficient than copper formulations when compared on a basis of equivalent cost. An experiment was therefore carried out with a view to assessing the optimum dressing rates for a range of mercurial compounds formulated as highly coloured powders in a range of concentrations. Results are shown in Table 8. Owing to the prevailing droughty conditions, the infection level recorded in the untreated control was not as high as is often recorded at Ukiriguru and, in consequence, the differences between dressings may not reflect the differences which would have occurred under wetter conditions. There was, however, a clear indication that formulations containing the more toxic alkyl derivative, ethyl mercury chloride, were more efficient than formulations based on aryl derivatives only or formulations based on inorganic derivatives.

The use of these more toxic formulations on a commercial scale is dependent on the development of new seed dressing machinery in which the dust hazard to the operators is reduced to a minimum. A new machine is at present under test at Bukumbi ginnery near Ukiriguru and it appears that with some modifications this machine may be suitable for use with most types of dry mercurial seed dressings.

From the results in Table 8 there seem to be no consistent differences between given quantities of the same mercury compounds formulated at different concentrations. In this experiment, the dressings were applied by vigorous shaking for ten minutes in closed containers. Experience with seed treatment on a commercial scale, however, suggests that the higher dressing rates (and hence, from economic necessity, the 1% formulations) are to be preferred, in that the greater volume of dressing applied gives a more complete coverage.

TABLE 8.

PERCENTAGE SEEDLINGS SHOWING INFECTION DUE TO *X. malvacearum* AT 21 DAYS FROM PLANTING (MEANS OF 3 REPLICATIONS)

Rate of application of mercury (gm Hg per kgm of seed)	*1% formulations*				*3% formulations*		*5% formulations*				*Number of seedlings scored per mean observation*	*Actual dressing rates (w/w)*		
	PMU	PMA	PMA/EMC	MC/MI	PMA	PMA/EMC	PMU	PMA	PMA/EMC	MC/MI		*1%*	*3%*	*5%*
(1) 0·18	—	—	—	—	—	—	3·6	1·1	2·5	2·3		—	—	1:278
(2) 0·15	—	—	—	—	1·5	0	6·1	1·5	4·5	3·5		—	1:200	1:333
(3) 0·12	3·5	2·1	2·3	7·5	5·0	2·6	2·9	5·1	0·7	2·4	408·5	1: 83	1:250	1:416
(4) 0·09	4·0	4·1	1·3	4·8	3·3	1·2	3·5	5·3	1·4	2·8		1:111	1:333	1:555
(5) 0·06	7·6	5·4	1·5	1·6	4·7	3·4	—	—	—	—		1:167	1:500	—
(6) 0·03	6·4	4·4	1·3	3·9	—	—	—	—	—	—		1:333	—	—
Means (1) to (6)	5·4	3·9	1·6	4·4	3·7	1·8	4·0	3·3	2·3	2·7	1634			
Means (3) and (4)														
(a) individually	3·8	3·1	1·8	6·2	4·3	1·9	3·2	5·2	1·0	2·6	817			
(b) all combined		3·61			—			3·40			6536			
(c) PMA and PMA/EMC		2·44			3·04			3·09			3268			

Controls:—

(a) Perecot at 1:200 w/w — 6·2 (659 seedlings)
(b) Untreated (excluded from main trial) — 31·8 (201 seedlings)

General means for mercurial dressings:—

	1% and 5% formulations (3,268 seedlings)	1%, 3% and 5% formulations (4,902 seedlings)
PMU	4·66	—
PMA	3·66	3·68
PMA/EMC	1·95	1·92
MC/MI	3·52	—

Key to dressings:—

PMU — phenyl mercury urea
PMA — phenyl mercury acetate
PMA/EMC — mixture of phenyl mercury acetate and ethyl mercury chloride
MC/MI — mixture of mercury chloride and iodide

Results from seed treatment trials, such as the one just described, often show irregularities in spite of elaborate precautions to eliminate such sources of experimental error as operator differences, non-random distribution of infestation in the seed, differences in soil conditions, etc. In view of this, small-scale experiments were carried out on the conditions affecting the occurrence of seed-borne infection. Depth of planting was shown to affect the incidence of infection, as also were soil temperature and moisture during germination, whilst weather conditions after emergence were shown to be important in regard to secondary spread of infection from cotyledon to cotyledon. The most striking result, however, was the influence of the number of seeds planted per hole. In one experiment 8% infection was recorded when seeds were planted singly, rising to 62% where six seeds per hole were planted.

Normal planting practices, which include six seeds per hole, have always been used in seed treatment trials and it would seem that whilst variations in planting depth may account for some of the irregularity, the major irregularities arise from the spread of infection between contiguous cotyledons during and after emergence. Consideration of the statistical implications of this shows that wide variations in recorded levels of infection would be expected in small samples and that results would not lend themselves readily to statistical analysis. This has important bearings on the design of seed treatment trials and the interpretation of results.

Trash-borne Infection

Studies on the survival of *X. malvacearum* showed that the organism could be detected in a pathogenic state in trash, left after harvest to weather in the field, up to the third week in December, and that sterilisation was complete by 8th January. In a further experiment, trash exposed to the weather on 26th March showed a fall-off in pathogenicity from the beginning of May, being completely sterile by 9th June.

Accumulated evidence on the survival of *X. malvacearum* in cotton trash points to the fact that wetting is the operative factor in the onset of sterilisation. Survival of the organism in a pathogenic state through the dry season is almost certainly dependent on the amount and distribution of rainfall. Further work is required in order to define, more precisely, the conditions under which the pathogenicity of the organism may be expected to decline to nil.

Other experiments showed that only where trash was lying on or near the surface of the soil was infection recorded in an ensuing crop. Where the trash was buried, as would happen with ridge cultivation, no infection attributable to the presence of trash could be detected.

These results point to the fact that trash-borne infection may be

expected to be of negligible importance where ridge cultivation is practised. Where cultivation is on the flat, trash infection may be important in years when the pre-planting rains are light or where planting is early.

Fusarium Wilt

BY

D. A. PERRY (Namulonge, Uganda)

During 1959 an intensive investigation into the cotton wilt disease caused by *Fusarium oxysporum* f. *vasinfectum* was begun in Geita District. A reliable survey was made and information on resistance to wilt in some cotton varieties was obtained from variety trials situated on infested land.

The survey of the shambas in which cotton wilt was present was undertaken by the Department of Agriculture, and the writer worked in close collaboration with Mr. W. Mathewson, Agricultural Officer, Geita. A Field Assistant, who was trained to recognise wilt symptoms, worked solely on the collection of data throughout the season. In addition to recording and confirming by visits the numbers of shambas affected by wilt, information on the severity of the disease, the number of years of continuous cotton cultivation on affected shambas and the soil type of the shamba was obtained. Surveys of the extent of wilt had also been made in 1957 and in 1958 and the comparison between the two previous years and 1959 is shown in Table 9.

Table 9

Number of shambas with wilted cotton

	1957	*1958*	*1959*
Karumo Chiefdom	99	160	155
Buchosa Chiefdom	68	106	304
Totals	167	266	459

These data must be treated with some reserve. On the one hand, as experience has been gained, each year's survey has been more efficient than that of the previous year, so that apparent yearly increase in incidence of the disease may have partly been due to this cause. On the other hand, some severely infested shambas in earlier years would have been abandoned, or planted to other crops, in later years, and to this extent incidence of disease in later years is under-estimated. Further under-estimate in 1959 was due to the fact that no survey was possible in some areas of Karumo. These sources of error tend to cancel out, and this, supported by the opinions of the local people and of Departmental staff in the area, leads to the conclusion that the disease is almost certainly spreading, albeit slowly.

Records of severe wilt outbreaks were usually associated with continuous cotton cultivation, 5-7 years being common.

From wilted plants collected from 18 different areas, *F. oxysporum* f. *vasinfectum* was isolated and its identity proved by inoculation to young cotton plants in glasshouse experiments.

Trials designed to test the reaction of several cotton varieties to wilt were conducted on land where wilt had been seen in previous years in the Gunguli of Rugongo. It was found that Uk55 was slightly more resistant to wilt than was Uk51; in one trial the percentage of Uk51 plants with wilt symptoms was 5·5 and in a second trial it was 91, whereas the percentages in Uk55 were 3·8 and 86 respectively. Three Albar hybrids that were included in the second trial were much more resistant to wilt than either Uk51 or Uk55. These varieties had percentages of 40, 54 and 59.

The most reliable method of control of cotton wilt in other parts of the world has been to breed or introduce varieties that have been resistant to the disease. To embark on a full-scale programme of breeding for wilt resistance would be expensive and mean a re-organisation of the schemes in operation at Ukiriguru, and it is considered that the extent of the wilt disease in the Lake Province at the present time does not warrant such a programme. However, in order to be prepared for a possible steady increase of the disease, it is proposed that next season a plot on infested land should be used to select individual plants with increased wilt resistance from the strains selected at Ukiriguru for other desirable characters. Some of the lines in the variety trials of the past season have shown promise of providing a source of resistance. In this way it should be possible to obtain a stock of plants with wilt resistance that could be incorporated into the breeding scheme at Ukiriguru should the need arise.

Cotton Pests

BY

I. A. D. ROBERTSON (Entomologist, Department of Agriculture)

(*Included by courtesy of the Director of Agriculture, Tanganyika Territory*)

In general, the 1958-59 season has been one of very light insect attack. Pests were present on most crops and, locally, a fair amount of damage was done, but the overall picture shows what may probably be regarded as minimum loss of yield. The growing season was, in general, a poorish one owing to low rainfall, and it is considered likely that the unfavourable climatic conditions were the direct cause of the lack of serious insect damage.

Heliothis armigera

None of the biological work proposed last year has been carried out,

owing to shortage of specimens. Ukiriguru is the only place where facilities are available for doing biological work, and on Ukiriguru *Heliothis* was almost non-existent. Cotton was planted and arrangements made to carry out intensive sampling throughout the season. The study of life history and parasitism, however, requires a minimum of 100 larvae per week to give any valid results and the largest number of larvae taken in any one week was 24, so that the whole programme had to be abandoned.

Arrangements had been made to supply a research worker in Canada with adult moths, but again this had to be abandoned as insufficient adults to form a consignment were obtained.

Cotton

On Ukiriguru very little insect damage was done and this applied to most of Sukumaland. *Heliothis armigera, Earias insulana, Dysdercus fasciatus* and *D. nigrofasciatus* were present but in small numbers. Trial plots were laid out on Ukiriguru to investigate the possibility of reducing the cost of effective insecticide application and to compare the efficiency and cost of toxaphene in comparison with DDT. No spraying was however done, as insect damage was so slight that there would have been no chance of an economic return or even of a useful result.

Jassid was present in considerable numbers and for experimental purposes some non-resistant strains had to be sprayed.

It was reported that in the Seguti Valley a considerable but short-lived attack of *Heliothis* had developed in March and April.

Manonga (*Nzega*).—The area was visited in May and showed signs of a fairly heavy *Heliothis* attack in March and April. During the visit stainers were fairly numerous and spiny bollworm was present. It appeared that the stainer population might well build up to considerable proportions by the end of the season.

Nyamirembe (*Biharamulo*).—The new cotton growing areas situated in fairly heavy woodland showed remarkably little evidence of insect attack, good crops of grade A cotton being obtained. During a visit in August, however, a fairly heavy attack of pink bollworm was found. This pest may have moved from a wild *Hibiscus* host plant, but is more likely to have built up over the few seasons during which cotton has been grown in the area.

Bukoba.—The new cotton growing areas of Bukoba were visited in August and it was found that the crop had suffered heavily from insect pests. There had been a widespread attack of *Heliothis* in March and April, followed by a high stainer population in June and July. Spiny bollworm was present in August and again pink bollworm was present in fairly high numbers. The incidence of pink bollworm in this crop

can be explained by the overlap between the Uganda and Lake Province growing seasons caused by the change of seed and time of planting.

Cotton Spraying Trials

No extensive district trials were laid down by the Extension Division.

Kisangwa (*Musoma*).—A trial was laid down by the extension division and the results were as follows.

Planted 8/12/58. 6 tons FYM per acre

		Lb. seed cotton				
	Plot size	*A grade*	*C grade*	*Total*	*Value (Shs.)*	*Stand count*
Sprayed	½ acre	352	74	426	182·28	2928
Unsprayed	½ acre	343	97	440	182·10	3888

Spraying commenced on 3rd March 1959 and continued weekly until 10th April 1959, a total of 7 weekly sprayings which used 6½ pt. Didimac (2 lb. DDT) and ½ pint Gammalin (½ lb. BHC) at a cost of 36/- per sprayed plot. No economic result was obtained. It will be noticed, however, in the last column of the table that the stand count in the unsprayed plot was 30% higher than in the sprayed plot, and an amended value would show an increased return. The Officer in Charge states that the yields obtained in a season of poor rains were very low.

Appendix

Origin and Special Characteristics of the Main Cotton Strains Mentioned

Local	A mixture of Upland types introduced into the Lake Province from the turn of the century onwards—mainly from Uganda and Nyasaland.
Mz561	A straight selection from Mwanza Local, first multiplied in the 1939-40 season.
Uk51	A multiline seed issue incorporating strains with jassid resistance, first multiplied in the 1951-52 season.
Uk55	A multiline seed issue composed of 0/334 and 1/667 strains outstanding for yield and jassid resistance. First multiplied in the 1955-56 season.
Uk58	A multiline seed issue of selections from 0/334 and 1/667. First multiplied in the 1958-59 season.
8/290	A straight selection from a derivative of Mz561 made in 1948. Re-selection from 8/290 gave rise to the component strains of Uk55 and Uk58.
E21/15/504	A selection from third backcross material derived from Albar 51 crossed and backcrossed mainly to 8/290 derivatives.
Albar	Nigerian Allen (A1) blackarm resistance (bar) selections made at Namulonge. Two series of selections were made independently, Albar 49 in 1949 and Albar 51 in 1951.

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PROGRESS REPORTS FROM EXPERIMENT STATIONS

The reports for the seasons up to and including 1950-51 were published in seasonal volumes; the following are still in print and available at 3/- per volume post free.

1923-25 (one volume), 1926-27, 1931-32, 1934-35,
1935-36, 1942-43 and 1945-46 to 1950-51.

From 1951-52 the reports from each territory were published individually each season. A few of the 1951-52 reports are out of print, but all others are available post free at 1/- per report, or 7/6d. for the seasonal set.

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